

WE CLAIM:

1           1.    A glass article which includes a glass substrate  
2   having thereon a sputter-coated layer system comprising  
3   from the glass substrate outward, (a) a substantially  
4   metallic layer which includes nickel or a nickel alloy; and  
5   (b) an overcoat layer of silicon nitride ( $\text{Si}_3\text{N}_4$ ); and  
6   wherein the layers are each of sufficient thickness such  
7   that when the glass substrate has a thickness of about  
8   1.5 mm-13 mm and has the aforesaid layer system thereon the  
9   so-layered glass article is heat treatable, and has a  
10   visible transmittance of about 1-80% and a normal  
11   emissivity ( $E_n$ ) of about 0.10-0.60.

1           2.    A glass article according to claim 1 wherein said  
2   layer system does not contain any layer of silver; wherein  
3   layer (a) is substantially free of any nitride; and wherein  
4   said so-layered glass article is durable and chemically  
5   resistant.

1           3.    A glass article according to claim 2 wherein said  
2   layer system includes an undercoat layer of silicon nitride  
3   ( $\text{Si}_3\text{N}_4$ ) located between said substantially metallic layer  
4   and said glass substrate.

1           4.    A glass article according to claim 2 wherein said  
2   substantially metallic layer includes a minor amount of a  
3   metallic oxide of the metal in said metallic layer.

1           5.    A glass article according to claim 4 wherein said  
2 layer system includes an undercoat layer of silicon nitride  
3 ( $\text{Si}_3\text{N}_4$ ) located between said substantially metallic layer  
4 and said glass substrate.

1           6.    A glass article according to claim 5 wherein said  
2 layer system further includes a substantially  
3 stoichiometric metallic oxide layer overcoating, said  
4 substantially metallic layer and another substantially  
5 stoichiometric metallic oxide layer undercoating said  
6 substantially metallic layer.

1           7.    A glass article according to claim 6 wherein said  
2 undercoat and overcoat layers of substantially  
3 stoichiometric metallic oxide are each contiguous with said  
4 substantially metallic layer.

1           8.    A glass article according to claim 1 wherein said  
2 layer system comprises a plurality of alternating said  
3 substantially metallic layers and said silicon nitride  
4 ( $\text{Si}_3\text{N}_4$ ) layer is an undercoat layer located between said  
5 glass substrate and the first of said plurality of  
6 substantially metallic layers.

1           9.    A glass article according to claim 8 wherein said  
2 layer system does not contain any layer of silver; wherein

3 layer (a) is substantially free of any nitride; and wherein  
4 said so-layered glass article is durable and chemically  
5 resistant.

1 10. A glass article according to claim 9 wherein at  
2 least one of said substantially metallic layers includes a  
3 minor amount of a metallic oxide of the metal in said  
4 metallic layer.

1 11. A glass article according to claim 8 wherein the  
2 metal in each of said substantially metallic layers is the  
3 same nickel alloy and wherein said silicon nitride layers  
4 include a minor amount of a conductive metal.

1 12. A glass article which includes a glass substrate  
2 having thereon a sputter-coated layer system comprising  
3 from the glass substrate outward, (a) a layer comprised of  
4 a mixture of silicon nitride ( $\text{Si}_3\text{N}_4$ ) and nickel or a nickel  
5 alloy; and (b) an overcoat layer consisting essentially of  
6 silicon nitride ( $\text{Si}_3\text{N}_4$ ) and wherein the layers are each of  
7 sufficient thickness such that when the glass substrate has  
8 a thickness of about 1.5 mm-13 mm and has the aforesaid  
9 layer system thereon the so-layered glass article is heat  
10 treatable, durable, chemically resistant, and has a visible  
11 transmittance of about 1-80% and a normal emissivity ( $E_n$ ) of  
12 about 0.10-0.60.

1        13. A glass article according to claim 12 wherein  
2 said layer system further includes an undercoat layer  
3 consisting essentially of silicon nitride ( $\text{Si}_3\text{N}_4$ ) located  
4 between the glass substrate and said layer (a) and wherein  
5 said silicon nitride layers include a minor amount of a  
6 conductive metal selected from the group consisting of  
7 titanium, zirconium, chromium, hafnium, and mixtures  
8 thereof.

1        14. A method of heat treating a coated glass article  
2 comprising the steps of:

3                (a) sputter-coating onto a glass substrate a  
4 layer system comprising from the glass substrate outwardly,  
5 a substantially metallic layer which includes nickel or a  
6 nickel alloy; and an overcoat layer of silicon nitride; and

7                (b) thereafter subjecting this coated glass  
8 substrate to a heat treatment selected from the group  
9 consisting of bending, tempering, heat strengthening and  
10 combinations thereof; and

11                (c) wherein after this heat treatment the  
12 resultant article has a normal emissivity ( $E_n$ ) of about  
13 0.10-0.60 and a visible transmittance of about 1-80%, and  
14 wherein said visible and solar transmittance are changed  
15 less than about 20% by said heat treatment.

1        15. The method according to claim 14 wherein said  
2 visible and solar transmittance was changed less than about

3 10% by said heat treatment; wherein said layer (a) is  
4 substantially free of any nitride; and wherein said coated  
5 glass article both before and after said heat treatment is  
6 durable and chemically resistant.

1 16. The method according to claim 15 wherein said  
2 visible and solar transmittance was changed less than about  
3 2% by said heat treatment.

1 17. The method according to claim 14 wherein said  
2 sheet resistance ( $R_s$ ) was not increased more than about 10%  
3 by said heat treatment.

1 18. The method according to claim 17 wherein said  
2 sheet resistance ( $R_s$ ) was not increased by said heat  
3 treatment.

1 19. The method according to claim 18 wherein said  
2 sheet resistance ( $R_s$ ) was decreased by said heat treatment.

1        20. The method according to claim 14 wherein said  
2 layer system does not contain any layer of silver, wherein  
3 said layer (a) is substantially free of any nitride; and  
4 wherein said coated glass article both before and after  
5 said heat treatment is durable and chemically resistant.

1        21. The method according to claim 20 wherein said  
2 steps further include sputter coating onto said substrate  
3 an undercoat layer of silicon nitride ( $\text{Si}_3\text{N}_4$ ) located  
4 between said substantially metallic layer and said glass  
5 substrate.

1        22. The method according to claim 20 wherein said  
2 substantially metallic layer includes a minor amount of a  
3 metallic oxide of the metal in said metallic layer.

1        23. The method according to claim 22 wherein said  
2 steps further include sputter coating onto said substrate  
3 an undercoat layer of silicon nitride located between said  
4 substantially metallic layer and said glass substrate.

1        24. The method according to claim 23 wherein said  
2 steps further include sputtering a substantially  
3 stoichiometric metallic oxide layer overcoat above said  
4 substantially metallic layer and sputter coating another  
5 substantially stoichiometric metallic oxide layer undercoat  
6 beneath said substantially metallic layer.

1        25. The method according to claim 24 wherein said  
2 sputter coating of said undercoat and overcoat layers of  
3 substantially stoichiometric metallic oxide occurs  
4 immediately before and immediately after, respectively,  
5 said sputter coating of said substantially metallic layer  
6 so as to be contiguous therewith.

1        26. The method according to claim 14 wherein said  
2 heat treatment is conducted at a temperature from about  
3 1150°F - 1450°F.

1        27. The method according to claim 14 wherein said  
2 silicon nitride layer includes a minor amount of a  
3 conductive metal.

1        28. A method of heat treating a coated glass article  
2 comprising the steps of:

3            (a) sputter coating onto a glass substrate a  
4 layer system comprising from the glass substrate outwardly,  
5 a layer comprised of a mixture of silicon nitride ( $\text{Si}_3\text{N}_4$ )  
6 and nickel or a nickel alloy and thereafter an overcoat  
7 layer consisting essentially of silicon nitride; and

8            (b) thereafter subjecting the coated glass  
9 substrate to a heat treatment selected from the group  
10 consisting of bending, tempering, heat strengthening and  
11 combinations thereof; and

12 (c) wherein after this heat treatment the  
13 resultant article has a normal emissivity ( $E_n$ ) of about  
14 0.10-0.60 and a visible transmittance of about 1-80%, and  
15 wherein said visible and solar transmittance are changed  
16 less than about 20% by said heat treatment.

1 29. A method according to claim 28 which includes the  
2 further step of sputter coating an undercoat layer of  
3 silicon nitride ( $Si_3N_4$ ) so as to be located between said  
4 glass substrate and said layer of a mixture of silicon  
5 nitride ( $Si_3N_4$ ) and nickel or nickel alloy.

1 30. A method according to claim 29 wherein said  
2 silicon nitride includes a minor amount of a conductive  
3 metal.

1 31. A method according to claim 28 wherein said heat  
2 treatment is conducted at about 1150°F - 1450°F.